

## Soybean Nematode Management <sup>1</sup>

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### Nematodes that Attack Soybean

Soybeans have been grown relatively little in Florida in recent years, but their recent rise in value may cause some growers to consider growing them again. Part of that consideration should include the severe nematode problems of soybean in Florida. Growers must be aware of both the many nematodes that can hurt soybean production, and the serious increases in nematode risks to crops that follow soybean.

Nematodes attacking soybean include all the root-knot (*Meloidogyne* spp.) nematode species that occur in Florida. In addition, **reniform** (*Rotylenchulus reniformis*), lesion (*Pratylenchus* spp.) and **sting** (*Belonolaimus longicaudatus*) nematode populations are increased by soybean production and can cause damage as well. Each of these nematodes can be limiting factors in the production of soybean as well as other crops in Florida. Soybean cyst nematode (*Heterodera glycines*), important in previous years, affects only soybean among Florida agronomic crops. It has not been detected in Florida for many years since the decline in soybean production and the shift of much

of the previous soybean acreage to cotton, a non-host of soybean cyst nematode.

### Diagnosis

The presence or potential for nematode problems in soybean could be suggested by one or more of the following: 1) Cropping history of the field, e.g. two or more years of cotton production or other nematode-susceptible crops; 2) Above-ground symptoms including off-color and/or stunted plants in spots or large areas of a field; 3) Below-ground symptoms such as small knots on roots or stunted and swollen root tips.

### Aboveground Symptoms

Above-ground symptoms of nematodes attacking soybean are similar, and resemble those caused by many other kinds of root injury, such as disease or general nutrient deficiency. Irregular, oval shaped areas in the field may contain plants that are stunted and yellowed. Plants with nematode-damaged root systems wilt more easily under moderately dry conditions and recover more slowly than healthy plants when water becomes available. Severity of damage is unevenly distributed in the field. Near the end of the season, leaves of nematode-affected

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soybean plants may prematurely yellow and drop before those of healthy plants. Frequently, lines of these damaged plants may stretch along rows following the direction of usual soil cultivation.



**Figure 1.** Stunted and yellowing plants in an oval pattern caused by root-knot nematodes.

### Root Symptoms

All nematodes affecting soybean reduce feeder roots and cause root stunting. To clearly see root symptoms, roots should be carefully dug with a shovel for close examination. Below-ground symptoms differ, depending on the nematodes causing them, and are not always distinct enough to use as a sole basis for diagnosis.

**Root-knot nematode** infections cause the roots of soybean to swell into galls. These may not be obvious until the latter half of the soybean season. Root galling caused by nematodes on soybean may resemble *Rhizobium* nodules, and these can be confused when diagnosing a root-knot nematode problem. *Rhizobium* nodules on soybean roots grow on one side of the root, can be easily removed from the root and are a pink color inside. Root-knot nematode galls, on the other hand, grow around the small roots, are firmly attached, and are not pink on the inside

Roots infected with **soybean cyst nematode** (SCN) usually have reduced *Rhizobium* nodulation and are short, sparse, and dark in color. Small period-sized dot-like cysts on the roots can be seen with very careful examination. These are the developing females of soybean cyst nematode and can range in color from white to creamy yellow to dark brown.

**Other nematodes** may cause soybean roots to be stunted or pruned, and the roots are usually darker in color than healthy roots. **Sting** nematodes stop root growth, giving the appearance that roots have been cut off. **Reniform** nematodes are the most difficult to diagnose in the field and produce overall stunted root systems with few feeder roots. Extensive root decay caused by common fungi or bacteria often follows nematode injury, especially by lesion nematodes. A laboratory analysis is usually necessary to confirm cyst, reniform, lesion, and sting nematodes on soybean.

### Field Mapping

**Root-knot nematodes** can be monitored by observing root galling on susceptible crops. Carefully lift plants at regular intervals throughout a field and note on a field map the extent of galling at each site. This provides far more detailed information about the distribution of problems than can be obtained from lab analysis of one or two composite samples. Crop species and varieties on which galls are found can also give valuable clues to which root-knot nematode species are present in each location.

### Nematode Assays

Soybean is such an excellent host for many important plant-parasitic nematodes that a field planted to this crop should be sampled before any cash crop is planted in the same site. Samples should not be taken when the soil is dusty dry or soggy wet. Two sampling strategies may be employed. A general survey should be performed immediately after soybean has been harvested. A soil core to 10 inches deep should be taken for every 1 acre in a 10-acre block containing a uniform soil type and cropping history. In a more definitive strategy where a nematode problem is suspected, several soil cores from within and immediately around a poor growth site should be taken while soybean is still growing. Include portions of damaged roots with the soil sample.

Prior to taking samples, contact your county extension agent for information concerning available sampling tools, shipment bags and proper procedures for submitting samples. The cores should be

thoroughly mixed and a 1-pint sample extracted and placed in a sealed plastic bag and kept cool (not frozen) before immediate shipment to an advisory laboratory. When possible, roots and root fragments should be included in soil samples.

The Florida Nematode Assay Laboratory provides routine nematode identification to the general public. There is a charge for each sample. Sample kits available at county Extension offices contain instructions for collection and handling of samples, and packing and shipping materials. Payment must accompany samples when they are sent to the lab for analysis. Diagnostic laboratories in the private sector may have different procedures and fees, and provide different services.

## Management

Nematode management for soybean and following crops depends on identifying and monitoring nematode populations to choose tactics for each field. Careful choice and integration of crop rotation, other cultural practices, resistant varieties, and nematicides are required. The kinds of nematodes present and their distribution in fields must be known to:

1. identify fields that cannot be planted profitably, or where a different crop has better profit potential;
2. plan optimum crop rotations to minimize losses for following crops and reduce populations;
3. select appropriate resistant varieties; and
4. recognize fields where nematicide use might pay for soybeans or other crops.

### Limiting Movement of Nematodes

*Reniform* nematode is not yet established in all soybean land in Florida, so preventing its further spread within a local area or even a single farm is a very economical way of avoiding ("controlling") losses to it. Nematodes are easily spread in soil and infected plants, but can move only a few feet per year under their own power. Soil and trash on tillage or harvest machinery is a common means of spread, so do not go directly from a contaminated area to a clean

one. Work in clean fields before infested areas. Be sure that borrowed or hired equipment is clean of soil and plant material before it enters clean land. Remove soil from machinery, clothes, shoes, tools, etc. when leaving a contaminated area. Do not move whole plants with soil on their roots from contaminated or suspect soil. Do not use seed from an infested area, because soybean cyst nematode is commonly carried in soil pellets ("peds") mixed with soybean seed.

## Crop Rotation

Soybean generally is not a suitable rotational option for the nematode management of other crops. Soybean should not be planted either before or after cotton as both are hosts to important nematode pests including southern root-knot, reniform, and sting nematodes. The susceptibility of soybean to nematodes is so great that, even if planted as a forage, growing soybeans for more than one consecutive season could cause damaging levels of nematodes for subsequent crops. Unless sting nematodes are in a field, a crop of soybean should be followed by a summer planting of a grass crop such as field corn, sorghum, or bahiagrass, etc. These crops are the most likely to reduce populations of root-knot and reniform nematodes. Rotation is a good tool to help keep relatively low populations from becoming too high, or for gradually reducing high populations over several years. It should not be expected to abruptly reduce a root-knot nematode population, since:

- some of a nematode population will survive the winter without a host
- most crop plants can support at least a little nematode reproduction
- most planted fields have weeds that support nematode reproduction

Soybean is the only common agronomic crop that supports SCN. However, some leguminous weeds, some varieties of field peas (southern peas), and most edible beans apparently can support SCN reproduction, so avoid them in a rotation intended to reduce SCN and do not follow soybeans with these crops. An additional problem is that some of the eggs within a cyst of SCN may remain dormant but able to

hatch for many years if a suitable host begins growing nearby. There may well be enough (perhaps 5%-10% of the initial number) to initiate a new population 2 or 3 years after the cyst is produced, and a very few may well survive as long as 5 years. Therefore, rotation cannot be expected to reduce a high population of SCN rapidly, nor to eliminate a population.

Reniform nematode populations are likely to increase where cotton and soybean are grown frequently, and also will build up on many vegetables.

Rotations to reduce reniform nematodes should include corn, sorghum, other grasses, and/or peanut. Unfortunately, rotations are of little value for reducing lesion or sting nematode numbers, because they live well on so many different plants, including most grasses, soybean, most vegetables, and cotton. Lesion nematodes reproduce well on peanut and tobacco in Florida; sting does not.

Soybean is often planted behind a winter small-grain crop such as rye, wheat, or oats. A winter grain crop can help prevent erosion and weed growth, and provides income from the field twice per year rather than once. However, root-knot nematodes can infect new roots of many small grains planted while the soil is warm enough (above 65°F) to allow nematode infection of the grain crop before soil temperatures drop in winter. Rye, triticale, most wheat varieties, and barley can support root-knot nematodes; many varieties of oats support less or no reproduction. Reproduction in these grains may not actually increase root-knot nematode numbers, but may interfere with their normal overwinter decline. If planting is delayed until soil temperatures are lower, root-knot nematodes should not be able to reproduce in grains.

### **Resistant Varieties**

Considerable effort has been expended over the years to develop soybean varieties with resistance to soybean cyst and root-knot nematodes. Varietal resistance often controls specific nematodes most effectively. There are soybean varieties with resistance to one or more of the three common species of root-knot nematodes, and some populations of soybean cyst nematode. Some resistant to SCN also are resistant to the reniform

nematode. However, no variety is "nematode proof." "Resistance" refers to the total effect of one or more permanent physiological characteristics of a plant that reduces the effects of a nematode on the plant's performance and/or the ability of that nematode to reproduce on its roots. It does not imply absolute immunity to that nematode, and usually does not affect its relationships with other species or races of nematodes. Thus mixed populations of more than one nematode make choosing resistant varieties more difficult. Resistant varieties should be preferred when planting soybean. However, the following cautionary information must be considered in reference to root-knot nematode resistant soybean varieties. Resistance in these varieties is considered "quantitative" and is governed by a large unknown number of genes. Resistant varieties, therefore, may allow root-knot nematodes to survive and reproduce but at a lower level than susceptible varieties. This does not cause the resistance in a particular cultivar to fail but a considerable soil population of root-knot nematodes will remain following cultivation of a resistant soybean. Alternatively, soybean cyst resistance in soybean is considered "qualitative." Here resistance is conferred by a few dominant soybean genes. Compared to root-knot nematode, essentially no soybean cyst nematodes develop within a resistant cultivar. If soybean cyst-resistant cultivars are monocultured for a few years, resistance-breaking cyst nematodes will cause failure of that particular line of resistance.

Soybean varieties or lines are no longer tested in Florida for nematode resistance traits. However, when buying seed, consult with seed dealers and soybean seed companies to determine variety resistance to the three root-knot nematodes (Javanese, peanut and southern) commonly found in Florida soybean fields.

### **Nematicides**

Nematicides approved for nematode management of soybean are given in Table 1. There is little or no justification for using nematicides on soybeans produced for forage. For market production, growers should carefully consider costs and commodity price expectations before choosing nematicides for nematode management in soybean.

Temik 15G is available for use on soybean, but using this nematicide is subject to several use restrictions in general and more specifically in Florida. Before applying the product, read the label carefully, and in addition, request information from the Florida Department of Agriculture and Consumer Services (FDACS) on use restrictions and regulations for the product or go directly to their web site at: <http://www.flaes.org/temik/index.html>

Examples of the FDACS regulations regarding Temik include:

- Temik cannot be applied closer than 300 feet from a drinking water well.
- Fields to be treated with Temik shall be so posted conspicuously at least 24 hours before application and for a minimum of 30 days afterward.

**Table 1.** Nematicides that may be used for the management of nematodes on soybean.

<b>Nematicide</b>	<b>Application<sup>1,2</sup></b>	<b>Comment</b>
Telone II	28-56 fl. oz. / 1000 ft. of row/outlet	Pesticide costs and commodity market expectations must be carefully considered before application of nematicides in soybean production.
Temik 15G	11-15 oz. / 1000 ft. or row	As above.
<sup>1</sup> Please consult labels for pesticide handling and use restrictions.		